rstudio::conf(2020L)

List-columns in data.table

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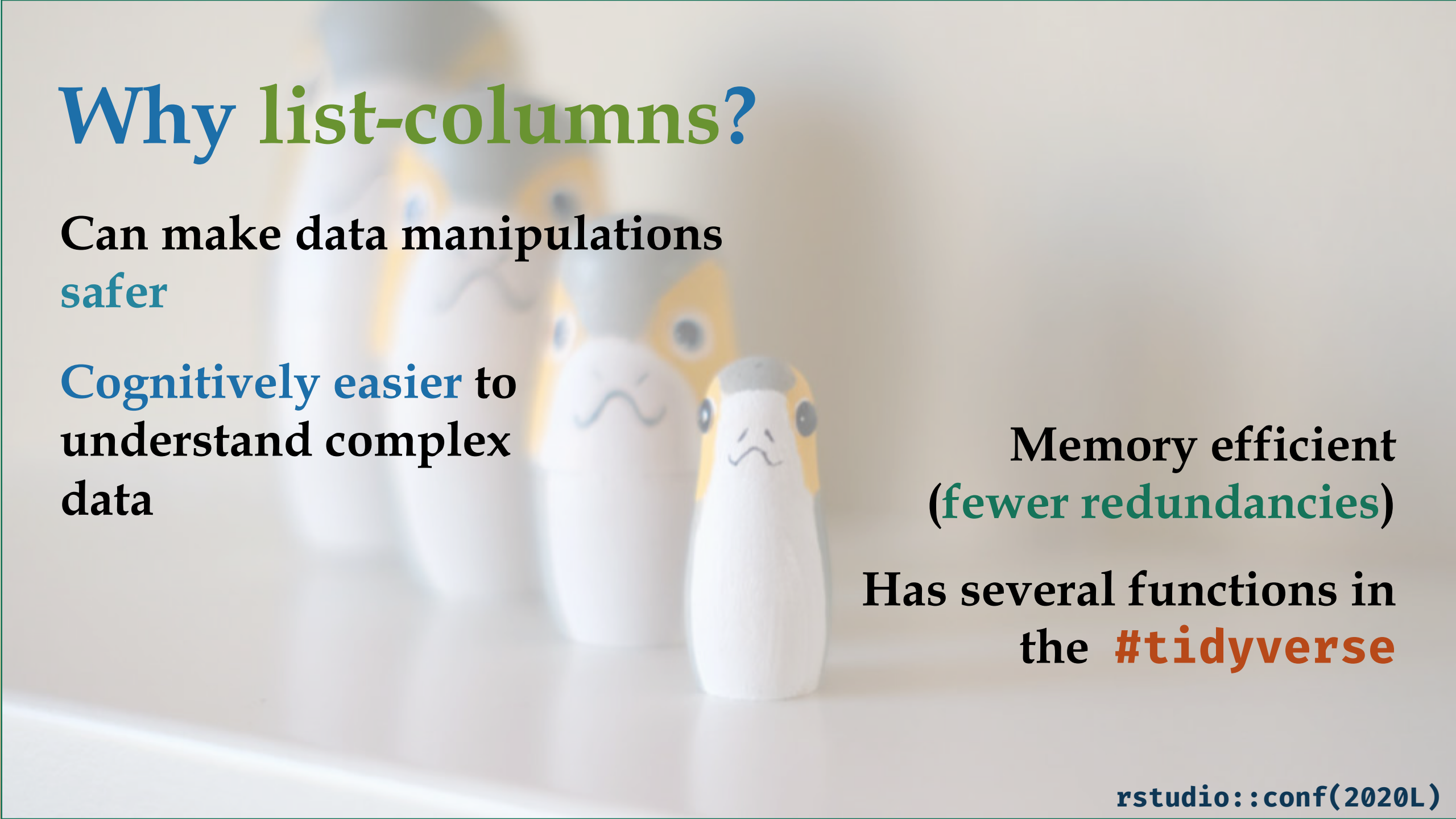
Absolutely Amazing Artwork by Allison Horst

Why list-columns?



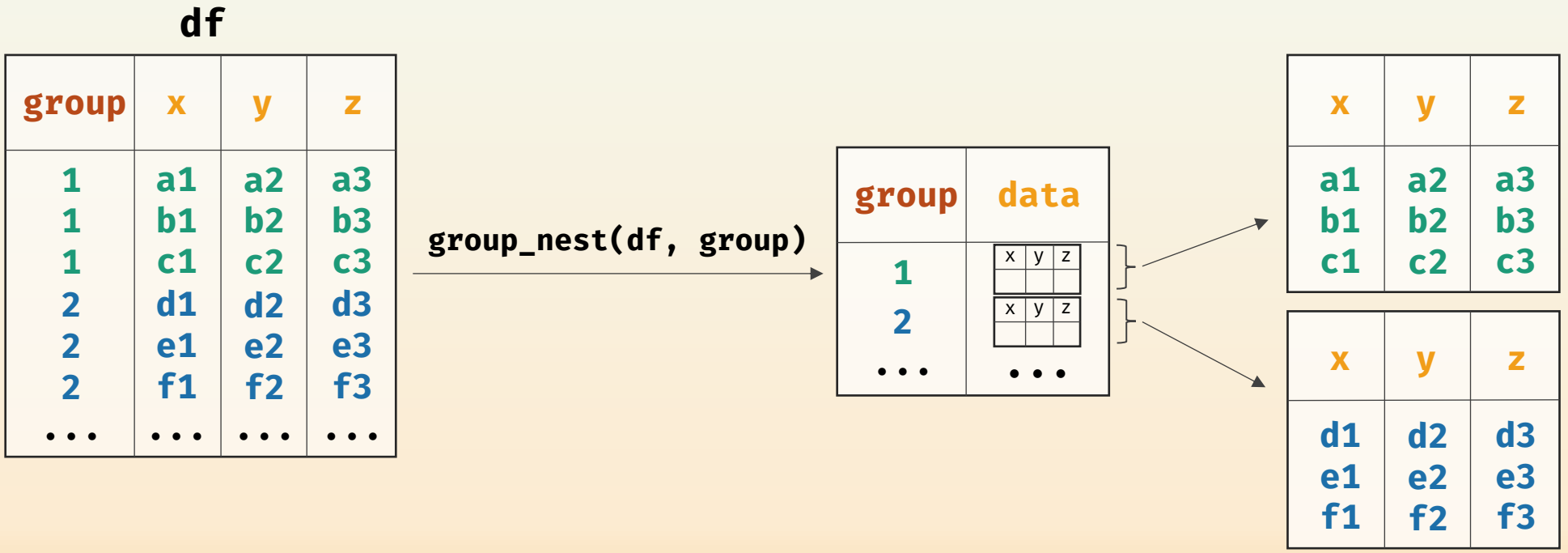
Can make data manipulations safer

Cognitively easier to understand complex data

Memory efficient (fewer redundancies)

Has several functions in the `#tidyverse`

What are list-columns?



Why `data.table`?

- Concise syntax
- Fast speed
- Memory efficient
- Careful API lifecycle management
- Community
- Feature rich

*According to the GitHub README

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Feature rich

```
dt[i, j, by]
```

"filter"

"mutate"

"group_by"

*According to the GitHub README

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Consistent

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https://h2oai.github.io/db-benchmark/

Summing by group

Input table: 1,000,000,000 rows x 9 columns (50 GB)

data.table	1.12.9	2019-12-12	1339s
(py)datatable	0.10.0a0	2019-11-24	2682s
dplyr	0.8.3	2019-12-05	timeout
pandas	0.25.3	2019-12-07	out of memory
spark	2.4.4	2019-12-05	not yet implemented
dask	2.9.0	2019-12-07	timeout
DataFrames.jl	0.20.0	2019-12-09	out of memory
ClickHouse	19.16.2.2	2019-12-09	CH server crash
cuDF	0.10.0	2019-12-05	out of memory
Modin		see README	pending

*According to the GitHub README

Let's Team Up

The Grammar

Nest making a list-column of data tables or tibbles

Hoist unnesting list-columns that have vectors in them

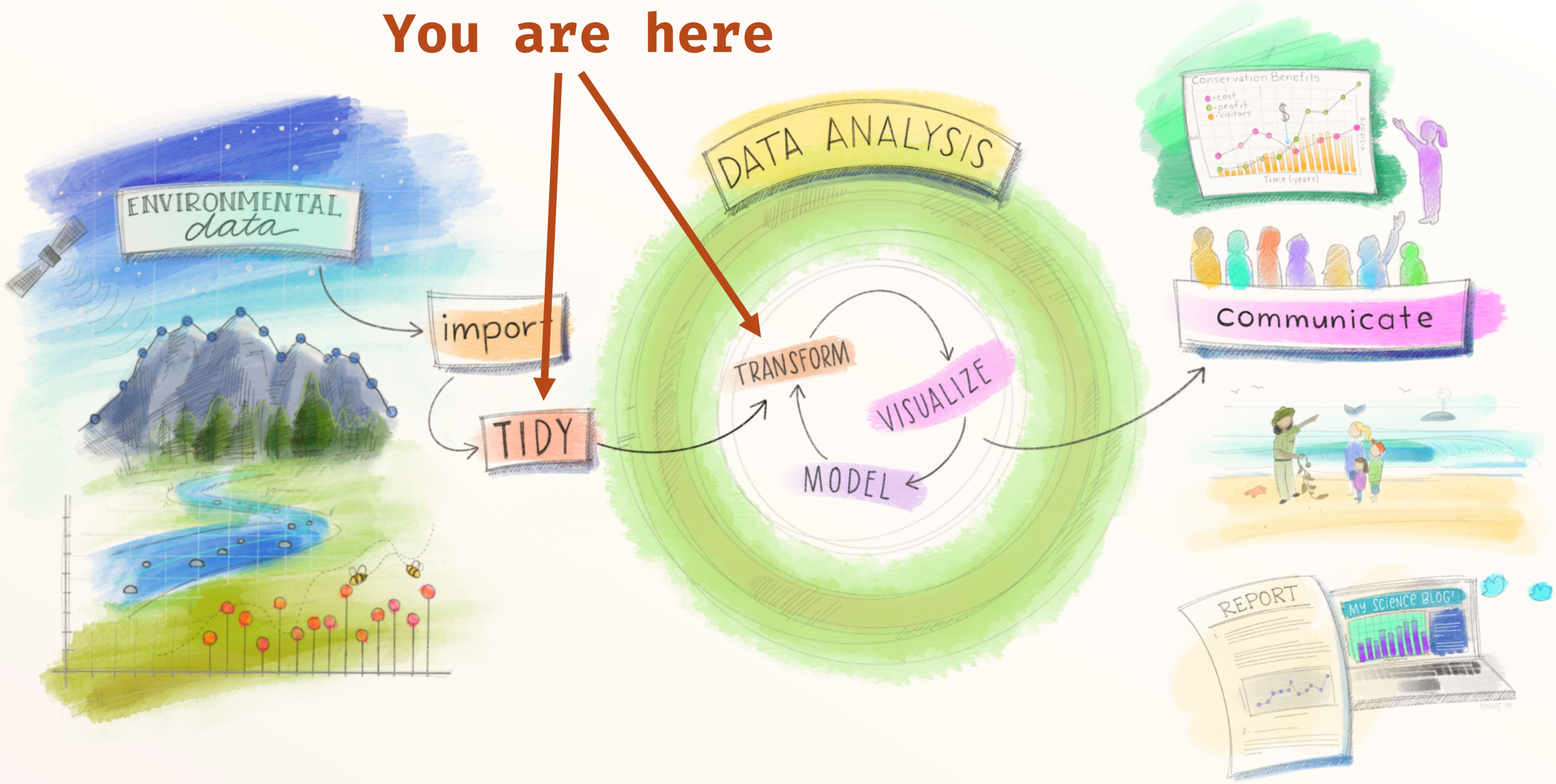
Unnest unnesting list-columns that have data tables or tibbles in them

Typing R Code

```
library(dplyr)
library(data.table)

dt_starwars <-
  as.data.table(dplyr::starwars)
```

Typing R Code

```
##    name                species homeworld films
##    <chr>               <chr>     <chr>   <list>
## 1 Luke Skywalker       Human   Tatooine  <chr [5]>
## 2 C-3PO                Droid   Tatooine  <chr [6]>
## 3 R2-D2                Droid   Naboo     <chr [7]>
## 4 Darth Vader          Human   Tatooine  <chr [4]>
## 5 Leia Organa          Human   Alderaan  <chr [5]>
## 6 Owen Lars            Human   Tatooine  <chr [3]>
## 7 Beru Whitesun lars   Human   Tatooine  <chr [3]>
## 8 R5-D4                Droid   Tatooine  <chr [1]>
## 9 Biggs Darklighter    Human   Tatooine  <chr [1]>
## 10 Obi-Wan Kenobi      Human   Stewjon   <chr [6]>
## # … with 77 more rows
```


You are here
ENVIRONMENTAL data
import
TIDY
DATA ANALYSIS
TRANSFORM
VISUALIZE
MODEL
Conservation Benefits
cost
profit
visitors
Time (years)
Communicate
REPORT
My Science Blog!

Typing R Code

`tidyfast` packages up the functions that use data.table

The variable `films` is currently a list-column of type: <char>
We can hoist that column so we can use each film

```
library(tidyfast)

films <- dt_hoist(dt_starwars,
                  films)
```

The data table

The list-column

dt_hoist()

The bulk of the work is just two lines

(everything else is mostly checks and formatting)

```
dt_hoist.default <- function(dt_, ...){
  if (isFALSE(is.data.table(dt_)))
    dt_ <- as.data.table(dt_)

  pasted_dots <- paste(substitute(list(...)))[-1L]
  classes <- sapply(dt_, class)
  typeofs <- sapply(dt_, typeof)
  v.names <- names(classes)
  keep <- v.names[classes != "list" & typeofs != "list"]
  drop <- v.names[classes == "list" | typeofs == "list"]
  drop <- drop[!drop %in% pasted_dots]
  keep <- keep[!keep %in% pasted_dots]
  keep <- paste(keep, collapse = ",")
  cols <- substitute(unlist(list(...), recursive = FALSE))

  if (length(drop) > 1)
    message("The following columns were dropped because ",
            "they are list-columns (but not being hoisted): ",
            paste(drop, collapse = ", "))

  dt_ <- dt_[, eval(cols), by = keep]
  dt_ <- .naming(dt_, substitute(list(...)))
  dt_
}
```

Typing R Code

Create a variable called data with all the data associated with each film

The data table

```
nested <- dt_nest(films, films)
nested[]
```

The list-column

Typing R Code

```
##    films                          data
##    <char>                         <list>
## 1: A New Hope                     <data.table>
## 2: Attack of the Clones           <data.table>
## 3: Return of the Jedi             <data.table>
## 4: Revenge of the Sith            <data.table>
## 5: The Empire Strikes Back        <data.table>
## 6: The Force Awakens              <data.table>
## 7: The Phantom Menace             <data.table>
```

dt_nest()

Again, the bulk of the work is just two lines

```
dt_nest.default <- function(dt_, ..., .key = "data"){

  # change to data.table
  if (isFALSE(is.data.table(dt_)))
    dt_ <- as.data.table(dt_)

  # groups
  by <- substitute(list(...))

  # call to data.table
  dt_ <- dt_[, list(list(.SD)), keyby = eval(by)]
  setnames(dt_, old = "V1", new = .key)
  dt_

}
```

.SD is a placeholder for the whole data table, excluding the keyby variable(s)

keyby sorts the data using data.table's super fast sorting

Typing R Code

```
revenue <- tibble::tribble(
    ~films,                        ~revenue,
    "A New Hope",                     775.4,
    "The Empire Strikes Back",        538.4,
    "Return of the Jedi",             475.1,
    "The Phantom Menace",            1027.0,
    "Attack of the Clones",           649.4,
    "Revenge of the Sith",            848.8,
    "The Force Awakens",             2068.2
 ) %>%
 as.data.table()

nested <- nested[revenue, on = "films"]   # join on films
nested[]
```

Typing R Code

```
##     films                 data          revenue
##     <char>                <list>          <num>
## 1: A New Hope         <data.table>  775.4
## 2: The Empire ...     <data.table>  538.4
## 3: Return of ...      <data.table>  475.1
## 4: The Phantom ...    <data.table> 1027.0
## 5: Attack of ...      <data.table>  649.4
## 6: Revenge of ...     <data.table>  848.8
## 7: The Force ...      <data.table> 2068.2
```

Typing R Code

Get some information from the data column (the list-column)
(Could use dtplyr here as well!)

```
prop_female <-
  films_unnest[, prop_genders :=
                   purrr::map(data, ~dt_count(.x, gender))]

films_unnest <- dt_unnest(prop_female, prop_genders)
films_unnest[]
```

Typing R Code

```
##     films              revenue gender          N
##     <char>             <num>   <char>          <int>
## 1: A New Hope          775.4   <NA>            3
## 2: A New Hope          775.4   female          2
## 3: A New Hope          775.4   hermaphrodite 1
## 4: A New Hope          775.4   male            12
## 5: The Empire ... 538.4   <NA>            2
## 6: The Empire ... 538.4   female          1
## 7: The Empire ... 538.4   male            12
---
```

From here, we can get the proportion of females to all characters and check the relationship between proportion and revenue

dt_unnest()

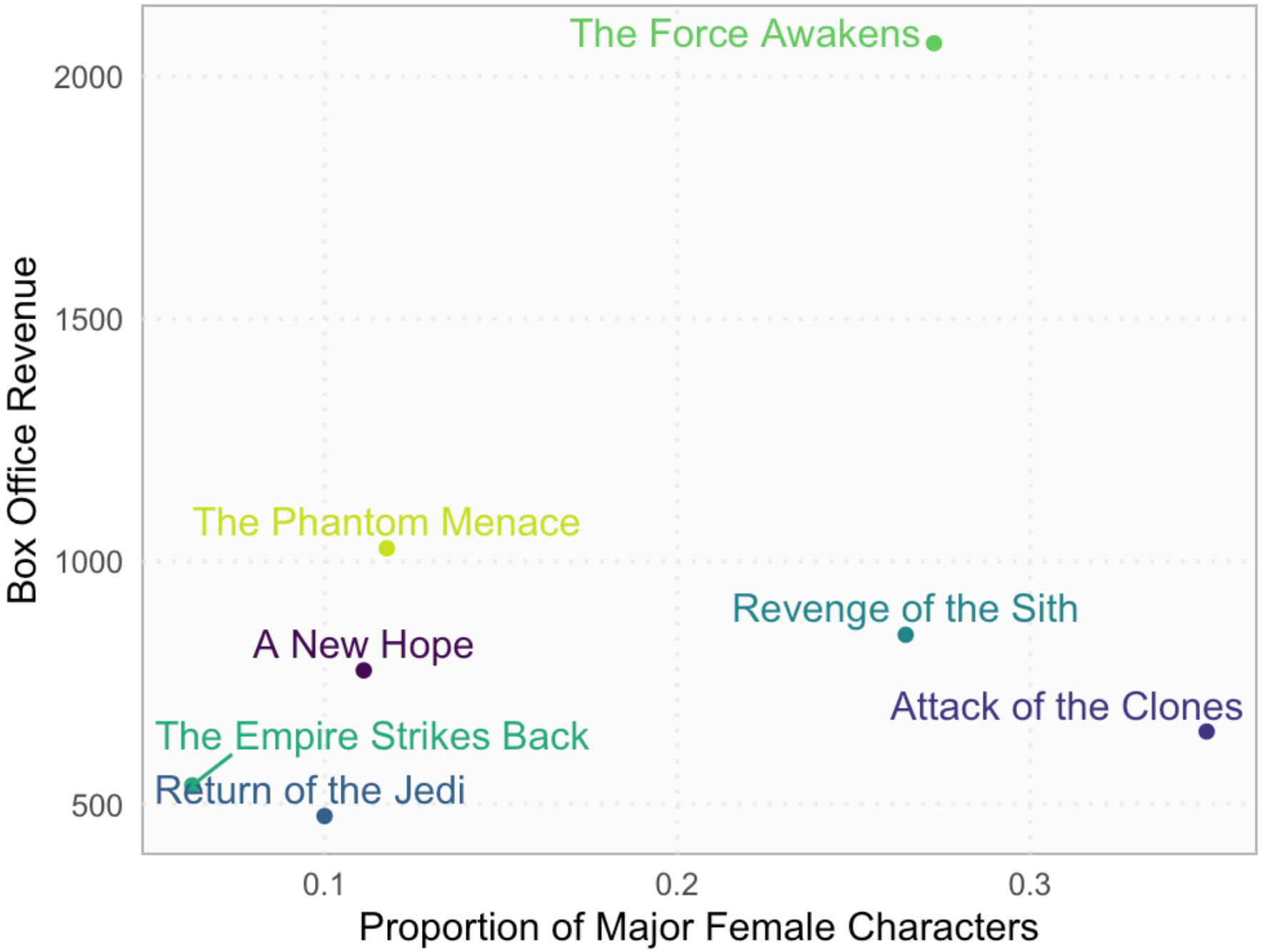
This one needed a few more lines of code but still only a few

```
dt_unnest.default <- function(dt_, col, ...){
  if (isFALSE(is.data.table(dt_)))
    dt_ <- as.data.table(dt_)

  col    <- substitute(col)
  keep   <- substitute(alist(...))
  names  <- colnames(dt_)
  others <- names[-match(paste(col), names)]
  rows   <- sapply(dt_[[paste(col)]], nrow)

  if (length(keep) > 1)
    others <- others[others %in% paste(keep)[-1]]

  others_dt <- dt_[, ..others]
  classes   <- sapply(others_dt, typeof)
  keep      <- names(classes)[classes != "list"]
  others_dt <- others_dt[, ..keep]
  others_dt <- lapply(others_dt, rep, times = rows)

  dt_[, list(as.data.table(others_dt), rbindlist(eval(col)))]
}
```

The ..others helps data.table to know to look outside of the table for the information (working with NSE)

rbindlist is data.table's super fast row binder

Results


The Force Awakens
The Phantom Menace
Revenge of the Sith
A New Hope
Attack of the Clones
The Empire Strikes Back
Return of the Jedi
2000
1500
1000
500
Box Office Revenue
0.1
0.2
0.3
Proportion of Major Female Characters
Data from Statista and SWAPI.

Cool, cool...

But what about performance?!

Nesting

```
#> # A tibble: 2 x 3
#>   expression   median mem_alloc
#>   <chr>      <bch:tm> <bch:byt>
#> 1 dt_nest      3.16ms    2.88MB
#> 2 group_nest   4.79ms    2.54MB
```

Unnesting

```
#> # A tibble: 2 x 3
#>   expression   median mem_alloc
#>   <chr>      <bch:tm> <bch:byt>
#> 1 dt_unnest     4.7ms    5.49MB
#> 2 unnest       12.6ms    8.47MB
```

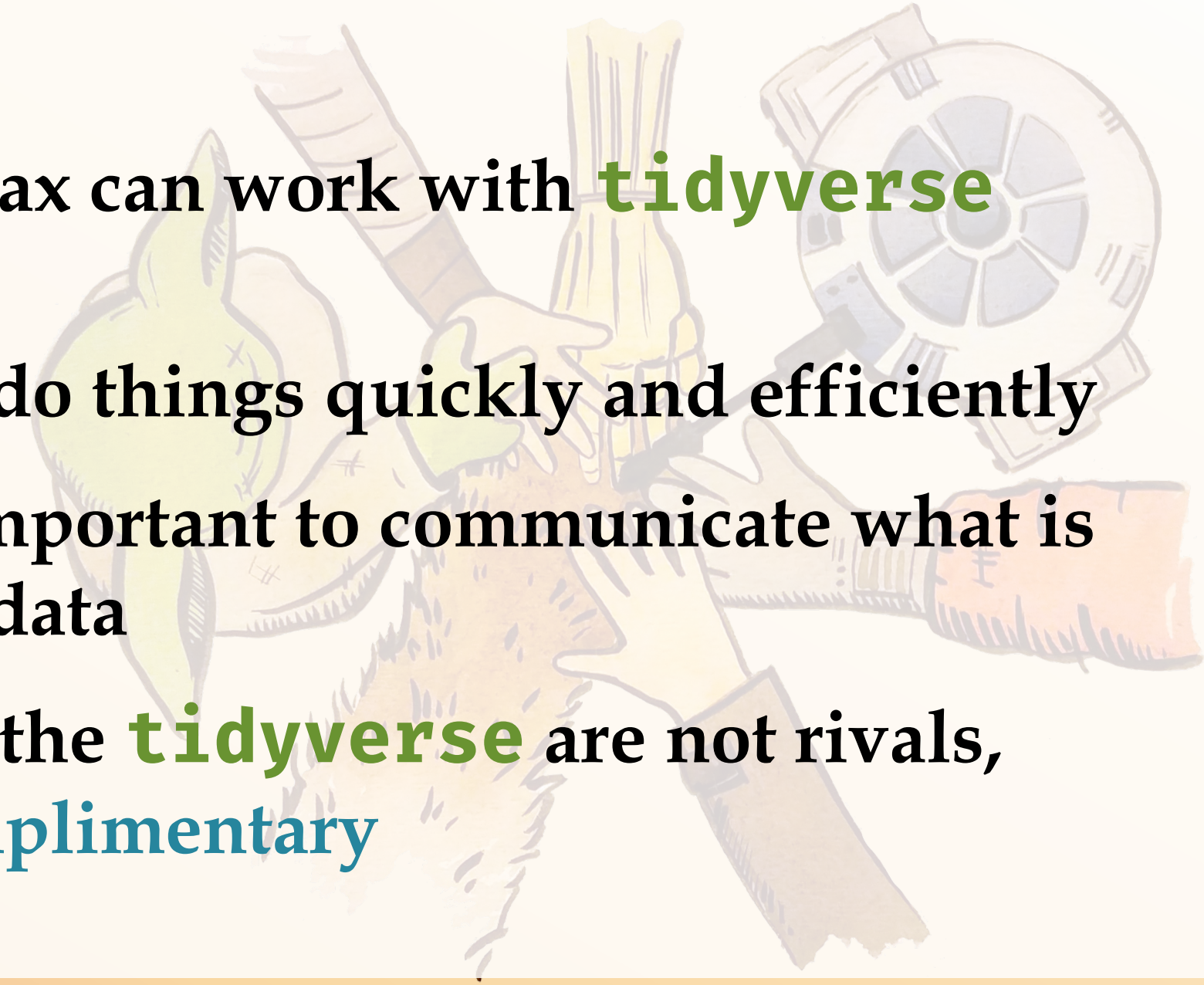
Takeaways

`data.table` syntax can work with `tidyverse` grammar

`data.table` can do things quickly and efficiently

The grammar is important to communicate what is happening to the data

`data.table` and the `tidyverse` are not rivals, but rather are complimentary



Links and Such

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 github.com/tysonstanley

 Slides at tysonbarrett.com/teaching